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MACKENZIE DELTA WILDLIFE:
AN HISTORICAL REVIEW OF MAN'S IMPACT

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When we speak of the "Mackenzie Delta Area" in terms of people and wildlife we cannot consider only the modern delta of the Mackenzie River. Before the arrival of Europeans the modern delta itself was little used relative to the surrounding areas, and, even with increased centralization of settlement, the people of the area ranged widely in their routine travels. This larger area may be reasonably considered to extend from the modern Mackenzie Delta west to Herschel Island and Lapierre House, south to the Fishing Lakes and Little Chicago, and east to Cape Bathurst and the forks of the Anderson River. It is this larger area that I will refer to as the Delta Area.

People probably first moved into the Delta area shortly after the end of the Wisconsin Glaciation, or at least 10,000 years ago. These people used the wildlife resources of the region as the basis of their livelihood, and continued to do so unimpeded for the next few thousand years. The entrance of Europeans into the region in 1789 (Alexander Mackenzie) was also prompted by the wildlife of the region, but in this case money making wildlife -- fur.

Although there was some fur trade in the Delta area through old Fort Good Hope between 1823 and 1826, fur trade in the region really developed only after the establishment of Peel's River Post (Fort McPherson) in 1840, Lapierre House in 1845, and Fort Anderson in 1861. Fur remained the main economic base of the Delta economy until bowhead whaling replaced it between 1889 to 1910. During this period the Delta Area was the centre of the whaling industry in the eastern Beaufort Sea and served as the winter port for a good portion of the Arctic Whaling Fleet; 74 ships wintered at Herschel Island and at least 24 ships wintered between Toker



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Point and Langton Bay. After 1910 there was an expansion and intensification of the fur trade, particularly noticeable in the 1920's. This boom eventually tapered off, however, and during the last 10 to 15 years industry based on ^{oil and gas} ~~the~~ exploration ~~for oil and gas~~ has become the main base of the Delta economy. It is probable that industry based on oil and gas exploration and the development of reserves will continue to be the base for the next few decades.

Recently much concern has been expressed by Delta Area residents and other environmentally conscious groups over the impact of petroleum exploration and development activities on the wildlife of the region. This concern is not surprising when one considers that the wildlife resources have been the mainstay of the Delta economy for all but about 10 of the last 10,000 years.

Recorded information on the wildlife of the Delta Area began with the explorer, Alexander Mackenzie, in 1789. Casual observations were also made by the Second Franklin Expedition (Franklin, Richardson) in 1825 and 1826, and by the Franklin Search Expeditions (Armstrong, Hooper, McClure, Miensching, Nelson, Pullen, Richardson) between 1848 and 1853. The most notable of these explorers was John Richardson who made a few biological collections in the Delta Area in 1826 and 1848.

The early fur traders (Isbister, MacFarlane, Ross) made somewhat more detailed observations on the wildlife of the region, as it was the basis of their livelihood. The most noticeable of these was Roderick MacFarlane who explored the Anderson River in 1857 and 1859 and established and operated Fort Anderson between 1861 and 1864. During this relatively short period, MacFarlane collected thousands of specimens of birds and

mammals in the Anderson River and Bathurst Peninsula area. These collections formed the ~~best~~ basis of our knowledge of the wildlife of the region *for the next 50-75 years.*
~~to that time.~~

The missionaries began activities in the Delta Area about 1860, but the only missionary notable for his observations on wildlife was Father Emile Petitot who was active in the region between 1865 and 1872. The whalers were active in the Delta area between 1889-1910, but were generally more interested in bowhead whales than in other wildlife. ^{However,} ~~but~~ a few of them (Bodfish, Cook, Klengenberg, Pedersen) made general observations.

A number of explorers visited the Delta Area between 1889 and 1907 (Harrison, Preble, Russell, Sainville, Seale, Stefansson, Stone) and most of them made observations on the wildlife of the region; in fact, several of the expeditions were specifically for collection of information on wildlife. Between 1908 and 1918, two significant expeditions visited the Delta area: the Stefansson-Anderson Expedition of 1908-1912, and the Canadian Arctic Expedition of 1913-1918. Largely through the work of Rudolph Anderson, these expeditions gathered much basic information on the birds, mammals and fish of the region. Anderson's work formed the best basis of information on the wildlife of the Delta Area since MacFarlane ~~and~~ ^{and} the information was largely non-overlapping as they concentrated their work in different parts of the region. Two other expeditions passed through the Delta Area in the early part of this century and made casual observations on the wildlife: the Cjoa Expedition of 1903-1907 and the Fifth Thule Expedition of 1921-1924.

Between 1927 and 1935, Alfred Porsild worked in the Delta Area, particularly near the modern Mackenzie Delta. He gathered the best

information on the wildlife of the region from its discovery in 1789 until after the Second World War. The information gathered by MacFarlane, Anderson and Porsild, along with the many casual observations of other visitors to the Delta Area, is the sum of our ^{documented} knowledge of the wildlife of the region for the first 150 years after its discovery. For the most part, however, this information consists merely of lists of the animals found in the region and some natural history observations. Little was known either of the detailed ecology of the Delta Area or of any of the animal species found there. There is, therefore, no real way of evaluating the impact of man's activities during that period.

There were two major sources of disturbance to the wildlife of the Delta region prior to about 1960: the fur trade and the whaling industry. Both of these, especially the whaling industry, were intensive programs designed to extract resources from the region with minimal cost and maximal profit. Little or no thought was given to long-term planned harvesting of these renewable resources until relatively recently, when controlled fur harvests were begun.

Hundreds of thousands of muskrat, beaver, martin, ^Kmines, wolverine, lynx, fox, and other "fur bearers" have been harvested in the Delta area since the establishment of the fur trade. That populations of these species still exist, despite the trapping pressure, cannot be taken as evidence that trapping has had no impact on them. However, it is virtually impossible to determine what the impact has been as no data is available on the populations prior to trapping and few studies have been done since.

One exception to this general case is the beaver. According to Knud Lang, 1867 was the last year beavers were taken in large numbers in

the Mackenzie Delta area, but they were still fairly numerous 1900 to 1910. Populations then declined and beaver were scarce by about 1925 and remained so until the Beaver Sanctuary was established in 1940. With protection, beaver increased and by 1947 there was a small scattered population on either side of the modern Mackenzie Delta. The increase was particularly noticeable after 1949, and, with minor fluctuation, remained high until 1965.

→ This general pattern suggests that the decline in beaver populations was the ^{direct} result of overtrapping. ^{However, other historical information does not confirm this pattern} However, Mackenzie inquired about various animals when he met a group of Indians near the outlet of Travaillant Lake in 1789 but reported: "As for the beaver, the existence of such a creature does not seem to be known by them". Beaver were not mentioned by several other early travellers on the lower Mackenzie River and modern Mackenzie Delta (Franklin, Hooper, Isbister, Pullen, Richardson) but Richardson reported that beaver inhabited the shores of the Mackenzie River to $67\frac{1}{2}^{\circ}$ or 68° North and MacFarlane recorded beaver on the ^aCornwath River and in the vicinity of Fort Anderson. This suggests that beaver may never have been very abundant in the Delta area. The historical data base is therefore inadequate to explain beaver population fluctuations in the region.

Beaver in the Delta area however have been studied by Canadian Wildlife Service personnel, principally Vern Hawley. These studies documented a sharp decline in the beaver population between 1965 and 1970 and found that the decline was associated with a degradation of food supplies rather than overtrapping. This suggests then that past fluctuations in beaver numbers may also have been more related to food supplies than to trapping pressure, although trapping cannot be entirely ruled out.

The whaling industry produced a more clear-cut impact on the wild-life of the Delta Area, and not only to bowhead whales. The whalers utilized large numbers of caribou, Dall's sheep, moose, muskox, rabbits, ptarmigan, and waterfowl for food. Only their impact on bowhead, caribou, and muskox has been noticeable.

Between 1889 and 1910 a total of at least 98 ships wintered in the Delta region: 74 at Herschel Island, at least 14 at Cape Bathurst and Baillie Island, nine at Langt^oan Bay, and one at Toker Point. Each of these ships had about a 50-man crew, about 10-12 Inuit hunters, and 20-50 dogs. These ships relied heavily on the wildlife of the Delta Area for winter meat supplies. Based on whalers' accounts and other available information, each ship used an average of about 13,500 lbs of game meat per winter, primarily caribou. Because of the distances game was hunted from the ships, normally only the "saddle" of the caribou was brought in; these weighed an average of 31.5 lbs. Therefore, between 1890 and 1908, whalers wintering at Herschel Island harvested at least 32,000 caribou ^(an average of 1800 per year) primarily from the Porcupine Herd, and between 1897 and 1910, whalers wintering east of the modern Mackenzie Delta harvested at least 10,000 caribou, primarily from the Bluenose Herd.

Because of the lack of baseline data, it is virtually impossible to estimate the magnitude of the impact of these harvests on the caribou herds. It is likely, however, based on present day information on the Porcupine Caribou Herd, that the harvest had negligible effect on the herd as a whole. However, Knud Lang observed that after the whalers, people had to travel far inland to hunt caribou, and not until 1926 did caribou reappear in the foothills west of the modern Mackenzie Delta. It is possible

then that the whalers' harvest affected the portion of the herd which normally winters in the northern parts of the wintering range, but this is only conjecture in the absence of good baseline data.

It is more likely that the whalers affected the portion of the Bluenose Herd using the Delta area. Early explorers (1827-1853) reported caribou on the Caribou Hills; on Ellice, Kendall, and Richards Islands; and along the Arctic coast of the Tuktoyaktuk Peninsula. Caribou were still reported as common in these areas in the 1890's but were observed to be declining rapidly by the early 1900's. This population was never very large and the harvest of at least 10,000 animals in only 13 years must have reduced the stock considerably and may have thereby altered traditional migration patterns. Porsild noted: "In many places on the Caribou Hills and in the Eskimo Lake basin deep-worn trails were still clearly visible in 1927 and 1928, and testified to the former presence of numerous caribou." The Bluenose Herd presently uses only a portion of its former range in the Delta area. Until about 10 years ago its range was essentially restricted to areas east of the Anderson River but since that time it has been expanding westward at least to the Kugaluk River and perhaps to Travaillant Lake area. Again, in the absence of firm baseline data an estimation of impact must remain conjectural.

The whalers also hunted muskoxen for winter food supplies. Information on either the original status of muskox in the Delta area or the actual harvest by whalers is very scant. MacFarlane reported

that in the 1850's muskoxen were uncommon between the Mackenzie and Anderson Rivers, but were common east of the Anderson River. Originally, muskoxen were probably little hunted by the inhabitants of the Delta area, but, after the establishment of Hudson Bay Company posts, many hides were brought in for trade. Anderson reported that by 1890 muskoxen had been extirpated

Relatively few whales were taken between 1889 and 1892 or after 1900; the peak of the hunting occurred in the intervening seven years, 1893-1899. In 1908, Inspector Jarvis of the North-west Mounted Police, Herschel Island Detachment, estimated that 1,345 bowheads were killed in Canadian waters between 1889 and 1907, and this appears to be a reasonable estimate. At least another 100 bowheads were taken in the Delta area between 1908 and 1915. Therefore, in only 27 years, and primarily in only seven years, almost 1,500 bowheads were taken in the eastern Beaufort Sea. Today only about 100 bowheads summer in the eastern Beaufort Sea. This tremendous reduction in the bowhead whale stock is almost certainly entirely due to the whalers.

We have, then, several cases of possible disturbance to Delta ^{as a result of} ~~a~~ Area wildlife, through man's activities. Only in the case of the bowhead is man clearly the culprit, although he is highly suspect in the cases of caribou east of the modern Mackenzie Delta and muskoxen. How detectable would these disturbances have been at the time they were occurring? I suggest that in several of the cases we would not have known the magnitude of the disturbance until it was very great due to the lack of solid baseline data. The question I would now like to raise is whether we are really any better off today in being able to assess disturbance to wildlife populations in the Mackenzie Delta Area.

After the Second World War more detailed studies began on the wildlife of the Delta Area, particularly on the economic species such as beaver, muskrat, and waterfowl. During the last 10 years, probably more manpower has been expended in the study of the wildlife of the region than had been during the previous 175 years. How good is our present data base?

(= published)

I would like to discuss the available_A information for each of the major groups of wildlife -- fish, birds, mammals -- as well as for some selected species. *When I speak of what we "know", I am referring only to published information.*

The Mackenzie Delta Area can be divided into four general drainages: (1) the Yukon River Basin, which includes the Porcupine and Bell Rivers; (2) the Yukon North Slope which includes the Firth, Babbage, and Blow Rivers; (3) the Mackenzie River Basin, which includes the Peel River and the modern Mackenzie Delta; and (4) the Eastern Coastal Drainage, east of the modern Mackenzie Delta, which includes the Miner, Kugaluk, Anderson, and Horton Rivers. The majority of the information available for the Delta region is from the first three of these drainages; virtually nothing is known of the Eastern Coastal Drainage.

The general distributions of the 61 species of fish reported from the Delta Area have been reasonably well documented for freshwater species in the ~~M~~odern Mackenzie Delta and west. However, little is known of their distributions east of the ~~M~~odern Delta and even less is known about their distribution in coastal waters.

(only about 50)
A total of known spawning sites and 40 known nursery sites have been located in the region, primarily since 1971. When these locations are mapped it can be seen that they appear to occur in discrete areas, rather than being scattered throughout the area. Further, these discrete areas lie principally along the proposed pipeline corridors. Therefore, the distribution of known spawning and nursery sites within the Delta area merely reflect where they have been looked for intensively and it cannot be assumed either that the most important have been found or that a stream crossing the pipeline route will not have an important site on it

outside of the corridor. Also, only about one-third of the species have recorded spawning sites and only about one-quarter have recorded nursery areas.

Although some species of fish in the Delta region are relatively sedentary, others follow seasonal migrations which may either be fairly local or over long distances. There is relatively little information available on these movements although we know that lake whitefish, broad whitefish, and inconnu summer in coastal waters and make long upstream migrations in the fall, perhaps as far as Fort Good Hope. Seasonal spawning migrations have been recorded for a few species of fish in parts of the region. Seasonal movements have been documented at only a few sites in the Delta Area (Aklavik, Arctic Red River, Rat River) and then only for one or two years. No information is available on long-term fluctuations in the timing or magnitude of seasonal movements or spawning runs.

Of the major fish species in the Delta Area, good biological data are available only for the Arctic char^b; the biology of most of the other species is generally poorly known. Burbot (or loche) and lake charr (lake trout) are conspicuous by the lack of information even on their reproductive patterns and movements, despite the importance of these two species to Delta ^BArea residents.

Because of the lack of good long-term, quantitative data on even the major fish species in the Delta ^AArea, it is unlikely either that any slight disturbance to their populations could be detected or that the exact cause of any major disturbance could be assigned.

The general distribution of the 118 species of birds reported breeding in the Delta ^{*}Area is reasonably well known; however, the ^{region}area east of the ^MModern Mackenzie Delta is generally poorly known compared with the ^MModern Delta and the area to the west. This is primarily due to recent research associated with the proposed pipeline corridors. Breeding bird surveys have been done in several areas along these proposed corridors since 1971 but only a very few sites have been sampled for more than one year. Therefore, no information is available on potential annual fluctuations in either the composition or density of the breeding bird populations. Without such data it is impossible to determine whether any changes detected in these communities at a future date are due to man-induced disturbance or to "normal" variations caused either by annual differences in weather patterns or fluctuations in some of the species themselves.

Probably the two most important groups of birds to the Delta ³Area residents are ptarmigan and waterfowl. Very little is known of the biology of any of the three species of ptarmigan or any of the 16 species of ducks breeding in the region, but the situation is better for the Whistling Swan and the four species of geese.

^M_A Aerial census of waterfowl has ^Sbeen made in the Delta ²Area each spring since 1948. These surveys show the great variation in both the composition and density of waterfowl between years due to natural variations in weather patterns. The greatest duck densities and the highest proportion of dabbling ducks (primarily Pintail, Wigeon, and Mallard) was found around 1960, which coincides with a period of drought on the prairies. In dry years, waterfowl which normally nest in prairie ponds

move further north where conditions are always wet. ~~Witho~~

Without such a continuous record of waterfowl populations, changes in numbers either could not be assigned to a cause or could be misconstrued. Porsild reported that nesting Canada Geese in the southern part of the ^mModern Mackenzie Delta decreased markedly in the period 1915-1935, and attributed this decrease to the increase in human activities in the region. Because of the lack of a data base Porsild could not either truly document the decrease or assign its cause with any accuracy. Cowan, a biologist, who visited the Modern Mackenzie Delta in 1947, compared his waterfowl observations with those of Porsild who was there in 1934. Cowan reported a total decline in waterfowl populations of 91-97 [%] percent, with the decline in Wigeon and Pintail approaching 99 [%] percent. Cowan expressed great concern over this disastrous decline. However, the apparent decline was probably due to the great numbers of prairie waterfowl present in the Delta ^{area} during the dry years of the 1930's as compared to more normal densities when Cowan made his observations in 1947. Because he did not have a good data base, Cowan could not reach this conclusion.

These cases, I feel, emphasize the need for a long-term data base for the assessment of the effects of potential disturbance. The base must be sensitive however. The aerial surveys of waterfowl run since 1948 give us a base to detect changes of relatively large magnitude but the technique is relatively insensitive and would not enable small scale disturbances to be detected.

Largely through the efforts of Dr. Tom Barry of the Canadian Wildlife Service, who has worked in the Delta ^{Area} for over 15 years, we have good information on the biology of Whistling Swan and geese

(Brant, Snow, White-fronted, and Canada) in the Delta ²Area. This information is essential because the greatest density of Whistling Swans in Canada is found along the coastal strip from the west side of the ^mModern Mackenzie Delta to the east side of the Anderson River Delta, and because over 15,000 Snow Geese, 3,000 Brant, and 6,000 white-fronted Geese breed in the Delta ²Area. Barry has also collected vital information on the location of critical areas within the Delta region for migration, nesting, and moulting of waterfowl.

Two major waterfowl migration pathways in northwestern North America pass through the Delta area; the coastal route around Alaska used by Brant, ^{Oldsquaw}~~Geese~~ and eiders; and the Mackenzie River Valley, used by the remaining waterfowl species. Because of these major migration routes, most of the waterfowl which breed in the western Arctic pass through the Delta ²Area in spring and fall. Barry reported that in late May and early June 1972, almost 200,000 geese, over 1,100,000 ^{Oldsquaw}~~Geese~~, and almost 1,250,000 eiders passed Cape Dalhousie on migration. The need for detailed baseline data is clear.

Barry's studies on the reproductive biology of geese in the Delta ²Area have shown ^{the}~~their~~ sensitivity ^{of geese disturbance}~~to disruption~~ during the breeding season. Because of the short Arctic summer the schedule of goose nesting activities is very tight. Once nesting can begin there is only about a 10-day period during which all other nests are initiated. Incubation begins after the last egg of the ^{clutch}~~cluster~~ is laid and lasts 22-24 days, depending on the species. Young geese grow rapidly and this rapid growth is necessary if the young birds are to be able to migrate south with their parents at the end of the summer. Because of this tight schedule,

The distribution of most of the 42 species of mammals resident in the Delta ~~Area~~ is probably better known than those of fish and birds. However, we have good information on the biology of only a few of these species. The aquatic furbearers, beaver and muskrat, have received the greatest amount of attention, primarily through the work of Vern Hawley and Ward Stevens of the Canadian Wildlife Service. Beaver and muskrat habitat has been surveyed and classified as to its potential for fur production, and detailed studies have been done on both species in the ~~Modern~~ Mackenzie Delta. From this work we know that populations of both species fluctuate greatly over the years but they do not fluctuate together. In the last 15 years beaver populations were highest between 1962 and 1965 and then declined, probably due to a degradation of food supplies, while muskrats were very high in 1962 and 1968 and markedly lower in the other years. The cause of these fluctuations is not known and their predictability is not possible.

The detailed studies on beaver and muskrat have outlined the sequence of events in the animals' annual cycles and therefore provides insight into the periods of the year when the animals might be most vulnerable to disturbance.)

→ Extremely little is known of the biology of the remaining furbearers of the region, despite their economic importance. Arctic fox habitat has been mapped and some surveys of denning density were run on the Yukon North Slope during one year. Den site requirement of Arctic fox and red fox on Richards Island have been examined briefly. Except for this small amount of information, virtually nothing is known of the biology of either Arctic fox or red fox in the Delta ~~Area~~. → continue paragraph →

Some studies have been made on marten and mink but generally little is known. Virtually nothing is known of the biology of wolf, wolverine, and lynx in the Delta area.

As I pointed out earlier, when I say nothing is "known" I am referring to published information. It is impossible for a man to be a successful trapper and not know a great deal about the habits of the animals he is trapping, and there are many successful trappers in the Mackenzie Delta area. The trapper must be aware of the habitat types used by the animals for hunting and for shelter, and their times of activity and movement. The trapper is also very aware of the sensitivity of the animals to foreign odours, which may be found in traps and trapping equipment, and to the alteration to snow cover and vegetation caused by trapping activities. This knowledge is gained through many years of experience. The trapper is sensitive to changes in animal numbers and behaviour in the local areas he is familiar with. Because he does not have sufficiently detailed information on the animals' year long activities over a large area, he cannot always make accurate interpretations of his observations. With the general level of the data base available to biologists for the Delta area, we are not much better off.

The large mammals such as caribou, moose, and Dall's sheep are important in the Delta region as sources of food. It has only been within the last five years that any good data have been available on the great caribou herd west of the modern Mackenzie Delta. As much testimony has already been presented on the Porcupine Herd, I will not rediscuss it. Barren-ground caribou are also found in the Delta region east of the Kuglulik River; this is part of the Bluenose Herd. Little

.... ~~Ground~~

is known of these animals in the Delta area but studies are presently being carried out on them by Vern Hawley of the Canadian Wildlife Service.

European reindeer presently occupy much of the former barren-ground caribou range between the modern Mackenzie Delta and the Kuglulik River. These animals are presently being managed and consequently the effects of man-made disturbance may be more easily detected in these animals than in the other caribou herds in the Delta region. A group of probable reindeer-caribou hybrids occupies the range between the Eskimo Lakes and the Mackenzie River and centered on the Kuglulik River. This herd of about 1,000 to 2,000 animals has been only tentatively identified and virtually nothing is known about them.

Moose and Dall's sheep habitat has been mapped in the Delta area and the most important areas for these species have been identified. Except for this documentation of distribution, virtually nothing is known of the biology of moose or Dall's sheep in the region.

Until very recently, little was known of the biology of bowhead or beluga in the Delta area. Information gathered within the last 10 years, and particularly within the last 5 years, has greatly increased our knowledge of whale numbers and movements in the eastern Beaufort Sea, and the variations between years. However, the variation in this information gathered underlines the need for continuing studies if a good data base is to be established. Little information is yet available on the basic biology of whales in the Delta region.

Grizzly bear, polar bear and seals are also of importance to the people of the Delta area, and these animals have been receiving attention within the last few years. Surveys are being run by the Canadian

Wildlife Service to determine the distribution of polar bears, and ringed and bearded seals along the coast of the Delta region. More intensive work is presently being done in the eastern Beaufort Sea and Amundsen Gulf and this data will have some application to populations in the Delta region.

Grizzly bear habitat has been surveyed in the Delta area and some basic information on their biology has been collected. Presently more intensive studies of grizzly bears are being carried out by the Canadian Wildlife Service and these should produce a better data base for the evaluation of man-induced disturbance to grizzly populations.

Within the last 15 years there have been many cases of disturbance to wildlife in the Delta area. These have been due both to physical alterations to wildlife habitat, such as gravel pits, seismic lines, drilling sites, winter roads, and artificial islands; and to the increased presence of man and his machines. This latter case is exemplified both by the density of staging sites, seismic camps, and drilling rigs; and by the large amount of overland travel by Nodwells and trucks in winter, boats in summer, and airplanes and helicopters year round.

Residents of the Delta area have reported that fish in the Eskimo Lakes and Crossley Lakes and muskrats and snowshoe hare in the modern Mackenzie Delta have been affected by these disturbances. However, very little research has been done either to determine the effects of these disturbances or to confirm or deny the observations of Delta residents.

I have reviewed the historical evidence for disturbance to the wildlife of the Delta area by resource extraction industries in the past. We can be sure that present resource extraction based industries in the Delta area are also causing disturbance to Delta wildlife, however we do not know the magnitude of this disturbance. Because of the historical, present, and future importance of wildlife to residents of the Delta area, it is essential that the resource be maintained. This can be accomplished only through careful management of the resource to ensure firstly that the status of any component of the Delta fauna is not seriously altered, and secondly that the resource be available for continuing use by Delta residents.

Throughout this presentation I have emphasized the necessity for a solid, long term data base in order to detect and assess the effects of man-induced disturbances to wildlife populations. I do not feel that this can be overemphasized. The onus of proof should not be on the party who suggests that disturbance has occurred, for without such a data base he will not be able to demonstrate cause except in the most obvious cases, which are often only ones of very great disturbance. The onus of proof should rather rest on the party wishing to cause a perturbation to demonstrate that wildlife populations will not be affected. I believe that this is only possible with a solid long-term data base.

